

## CLAIMS

What is claimed is:

1. A membrane electrode assembly for an electrochemical fuel cell comprising:  
5 two fluid diffusion layers;  
an ion-exchange membrane interposed between the fluid diffusion layers;  
an electrocatalyst layer disposed at the interface between the ion-exchange membrane and each of the fluid diffusion layers;  
10 a fluid impermeable integral seal impregnated into the fluid diffusion layers in sealing regions thereof; and  
a barrier film interposed between the ion-exchange membrane and the fluid impermeable integral seals along at least a portion of the sealing region of at least one of the fluid diffusion layers wherein the barrier film is more chemically stable to acid  
15 hydrolysis than the integral seal.
2. The membrane electrode assembly of claim 1 wherein the barrier film is between the electrocatalyst layer and the fluid diffusion layer.
3. The membrane electrode assembly of claim 1 wherein the barrier film is between the ion-exchange membrane and the electrocatalyst layer.
- 20 4. The membrane electrode assembly of claim 1 wherein the barrier film is impregnated into the fluid diffusion layer.
5. The membrane electrode assembly of claim 1 wherein the fluid impermeable integral seal comprises silicone.

6. The membrane electrode assembly of claim 5 wherein the barrier film is a thermoplastic or a thermoset.

7. The membrane electrode assembly of claim 5 wherein the barrier film is polyvinylidene fluoride, polypropylene, polyethylene, polyolefins, PTFE, polyaryl  
5 ethers, PEEK, polysulfone, polyimide, epoxy, polyurethane, nitrile, butyl, or TPEs.

8. The membrane electrode assembly of claim 1 wherein the barrier film is a thermoplastic or a thermoset.

9. The membrane electrode assembly of claim 1 wherein the barrier film is polyvinylidene fluoride, polypropylene, polyethylene, polyolefins, PTFE, polyaryl  
10 ethers, PEEK, polysulfone, polyimide, epoxy, polyurethane, nitrile, butyl, or TPEs.

10. The membrane electrode assembly of claim 1 wherein the at least one of the fluid diffusion layers is the cathode fluid diffusion layer.

11. The membrane electrode assembly of claim 1 wherein the at least one of the fluid diffusion layers is both the anode and cathode fluid diffusion layers.

12. The membrane electrode assembly of claim 1 wherein the sealing  
15 regions circumscribe a central, electrochemically active area.

13. The membrane electrode assembly of claim 12 wherein the barrier film circumscribes the central, electrochemically active area.

14. The membrane electrode assembly of claim 1 wherein the fluid  
20 impermeable integral seal extends laterally beyond the ion-exchange membrane and the

fluid diffusion layers to thereby envelope a peripheral region of both of the fluid diffusion layers and the ion-exchange membrane.

15. A membrane electrode assembly for an electrochemical fuel cell comprising:

- 5 two fluid diffusion layers;  
an ion-exchange membrane interposed between the fluid diffusion layers;  
an electrocatalyst layer disposed at the interface between the ion-exchange membrane and each of the fluid diffusion layers;  
10 a fluid impermeable integral seal impregnated into the fluid diffusion layers in sealing regions thereof; and  
a fluid impermeable barrier plug impregnated into the electrode layers in regions adjacent to the sealing regions of at least one of the fluid diffusion layers.

16. The membrane electrode assembly of claim 15 wherein the fluid  
15 impermeable integral seal comprises silicone.

17. The membrane electrode assembly of claim 16 wherein the barrier plug is a thermoplastic or a thermoset.

18. The membrane electrode assembly of claim 16 wherein the barrier film is polyvinylidene fluoride, polypropylene, polyethylene, polyolefins, PTFE, polyaryl  
20 ethers, PEEK, polysulfone, polyimide, epoxy, polyurethane, nitrile, butyl, or TPEs.

19. The membrane electrode assembly of claim 15 wherein the barrier plug is a thermoplastic or a thermoset.

20. The membrane electrode assembly of claim 15 wherein the barrier film is polyvinylidene fluoride, polypropylene, polyethylene, polyolefins, PTFE, polyaryl ethers, PEEK, polysulfone, polyimide, epoxy, polyurethane, nitrile, butyl, or TPEs.

21. The membrane electrode assembly of claim 15 wherein the at least one of the fluid diffusion layers is the cathode fluid diffusion layer.

22. The membrane electrode assembly of claim 15 wherein the at least one of the fluid diffusion layers is both the anode and cathode fluid diffusion layers.

23. The membrane electrode assembly of claim 15 wherein the sealing regions circumscribe a central, electrochemically active area.

24. The membrane electrode assembly of claim 23 wherein the barrier film circumscribes the central, electrochemically active area.

25. The membrane electrode assembly of claim 15 wherein the fluid impermeable integral seal extends laterally beyond the ion-exchange membrane and the fluid diffusion layers to thereby envelope a peripheral region of both of the fluid diffusion layers and the ion-exchange membrane.

26. A membrane electrode assembly for an electrochemical fuel cell comprising:

two fluid diffusion layers;

an ion-exchange membrane interposed between the fluid diffusion layers;

an electrocatalyst layer comprising electrocatalyst particles and disposed at the interface between the ion-exchange membrane and each of the fluid diffusion layers; and

a fluid impermeable integral seal impregnated into the fluid diffusion layers in sealing regions thereof;

wherein at least a portion of the sealing region of at least one of the fluid diffusion layers is substantially free of active electrocatalyst particles.

5                   27.     The membrane electrode assembly of claim 26 wherein the at least a portion of the sealing region is substantially free of electrocatalyst particles.

28.     The membrane electrode assembly of claim 26 wherein the electrocatalyst particles in the at least a portion of the sealing region have been poisoned.

10                  29.     The membrane electrode assembly of claim 26 wherein the fluid impermeable integral seal comprises silicone.

30.     The membrane electrode assembly of claim 26 wherein the at least one of the fluid diffusion layers is the cathode fluid diffusion layer.

31.     The membrane electrode assembly of claim 26 wherein the at least one of the fluid diffusion layers is both the anode and cathode fluid diffusion layers.

15                  32.     The membrane electrode assembly of claim 26 wherein the sealing regions circumscribe a central, electrochemically active area.

33.     The membrane electrode assembly of claim 32 wherein the at least a portion of the sealing region circumscribes the central, electrochemically active area.

20                  34.     The membrane electrode assembly of claim 26 wherein the fluid impermeable integral seal extends laterally beyond the ion-exchange membrane and the

fluid diffusion layers to thereby envelope a peripheral region of both of the fluid diffusion layers and the ion-exchange membrane.